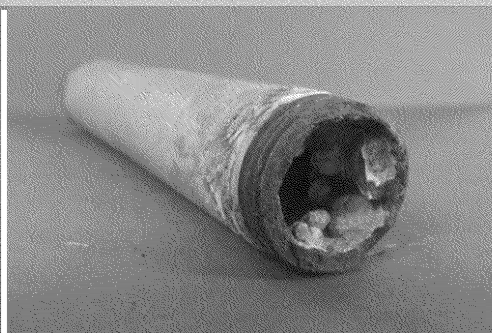




Office of Research and Development



Performance and Challenges of Point of Use Devices for Lead Removal

Michael R. Schock

Chemist, National Risk Management Research Laboratory

Tom Spoden

Product Certification Director, Water Quality Association



Disclaimer

The information in this presentation has been reviewed and cleared for public dissemination according to EPA policy. Mention of trade names or commercial products does not constitute EPA endorsement or recommendation for use.



Issues with Lead in Flint and Beyond

- ☐ Lead results from the field showed high levels and frequent occurrences of elevated lead above total lead certification (150 µg/L)
- ☐ Can current POU technology provide at least interim emergency treatment until corrosion control is re-established?
- ☐ Will POU technology be necessary long term for houses or buildings with lead or lead-bearing plumbing materials?
- ☐ How does POU technology compare to other approaches, such as bottled water?



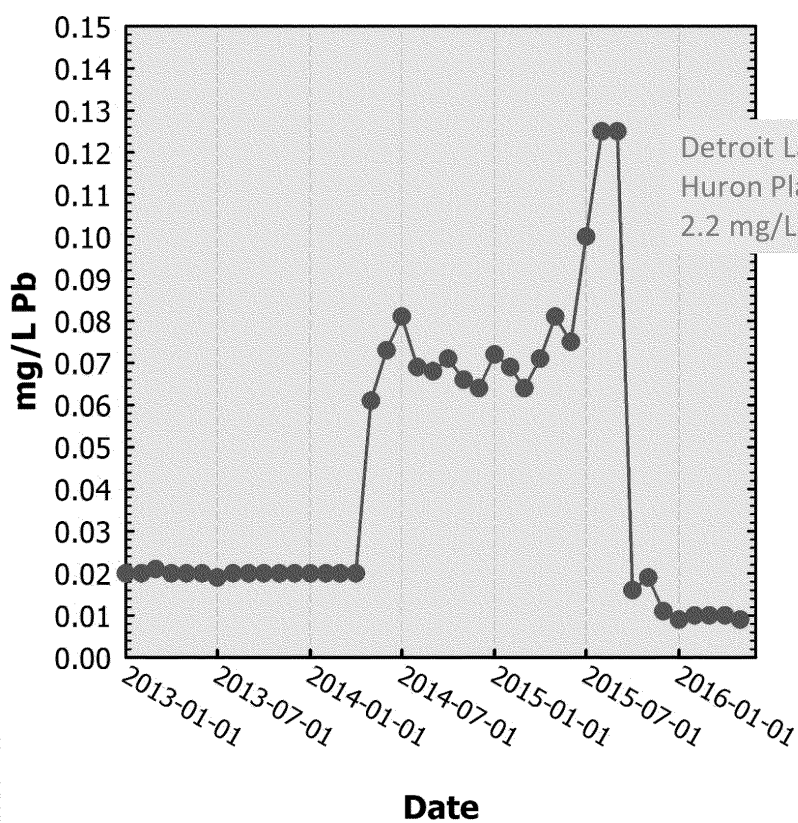
Fundamental Misunderstanding

- ☐ Total confusion about nature of lead occurrence
- ☐ Little appreciation or realization of dissolved vs. particulate occurrence in real plumbing systems
- ☐ Lead can occur as
 - Dissolved species, such as free lead ion or carbonate or hydroxide aqueous complexes
 - Particulate material
 - Eroded lead or galvanized pipe scale (up to ☐ 2% Pb when new)
 - Lead sorbed on to iron surfaces and eroded off, such as old galvanized pipe
 - Lead particulates from leaded solder or leaded brass
 - Miscellaneous distribution system sediment mobilized and passing through lead pipes, picking up lead



Flint Example: Computed Soluble Pb

(Using EPA-WSWRD LEADSOL computational model)





EPA POU Device Performance Assessment

- ☐ Study evolved slightly over time
- ☐ Initially targeted at sites with $>150 \mu\text{g/L}$ with first-draw samples
- ☐ Three types of samples, representing
 - Filtered water with existing POU device and cartridge (if present)
 - Unfiltered water: filter (if present) removed or bypassed
 - New faucet filter and/or cartridge (as appropriate)
 - Installed after unfiltered water grab sample was taken
 - Water flushed for 2 minutes through new unit
 - Grab sample collected through new cartridge/POU device
- ☐ March 2016 modified procedure with 6 hours stagnation for unfiltered samples



EPA POU Device Performance Assessment—Unfiltered Water

Parameter	Units	Summary of Filter Grab Results (January 30, 2016 - May 6, 2016)					
		Unfiltered Water					
		Minimum	Maximum	Median	Average	Standard Deviation	Number of Results
Aluminum	mg/L	Non-Detect (<0.009)	4.19	0.043	0.1462	0.3761	299
Cadmium	ug/L	Non-Detect (<0.061)	12	0.13	0.6577	1.2	299
Calcium	mg/L	Non-Detect (<0.2)	36	27	26.4	3.7	299
Chromium	ug/L	Non-Detect (<0.2)	14.1	0.24	1.3	2.1	299
Copper	ug/L	Non-Detect (<0.75)	16100	46	203.3	1006.1	299
Iron	mg/L	Non-Detect (<0.016)	110	0.086	1.0	7.4	299
Lead	ug/L	Non-Detect (<0.11)	4080	3	40.3	249.2	299
Magnesium	mg/L	Non-Detect (<0.048)	10.1	7.8	7.7	1.0	299
Manganese	mg/l	Non-Detect (<0.0011)	4.02	0.005	0.0287	0.2373	299
Nickel	mg/L	Non-Detect (<0.00023)	0.06	0.00094	0.0033	0.0065	299
Potassium	mg/L	0.043	29	1	1.1	1.7	299
Sodium	mg/L	4.1	180	4.8	6.0	11.3	299
Tin	mg/L	Non-Detect (<0.0013)	0.0424	0.02	0.0188	0.0104	12
Zinc	mg/L	Non-Detect (<0.0073)	13	0.055	0.2402	0.9306	299



EPA POU Device Performance Assessment—New Tap Filters

Parameter	Units	Summary of Filter Grab Results (January 30, 2016 - May 6, 2016)					
		Filtered Water - New Tap Filter					
		Minimum	Maximum	Median	Average	Standard Deviation	Number of Results
Aluminum	mg/L	Non-Detect (<0.009)	Non-Detect (<0.2)	Non-Detect (<0.009)	0.0475	0.0728	242
Cadmium	ug/L	Non-Detect (<0.061)	Non-Detect (<2)	Non-Detect (<0.061)	0.4	0.7	242
Calcium	mg/L	Non-Detect (<0.2)	27.2	18.6	16.2	8.2	242
Chromium	ug/l	Non-Detect (<0.2)	Non-Detect (<5)	Non-Detect (<0.2)	1.3	2.0	242
Copper	ua/L	Non-Detect (<0.75)	18	Non-Detect (<0.75)	1.0	1.3	242
Iron	mg/L	Non-Detect (<0.016)	Non-Detect (<0.1)	Non-Detect (<0.016)	0.0320	0.0287	242
Lead	ug/L	Non-Detect (<0.11)	1.01	Non-Detect (<0.11)	0.2148	0.1783	242
Magnesium	mg/L	Non-Detect (<0.048)	11.2	8.365	7.4	2.7	242
Manganese	mg/L	Non-Detect (<0.0011)	0.19	0.0016	0.0043	0.0131	242
Nickel	mg/L	Non-Detect (<0.00023)	0.0143	Non-Detect (<0.00023)	0.0013	0.0023	242
Potassium	mg/L	0.12	190	11	15.7	19.2	242
Sodium	mg/L	4.5	200	10	15.5	18.3	242
Tin	mg/L	Non-Detect (<0.0013)	Non-Detect (<0.02)	Non-Detect (<0.02)	0.0169	0.0073	12
Zinc	mg/L	Non-Detect (<0.0073)	0.02	Non-Detect (<0.0073)	0.0081	0.0015	242

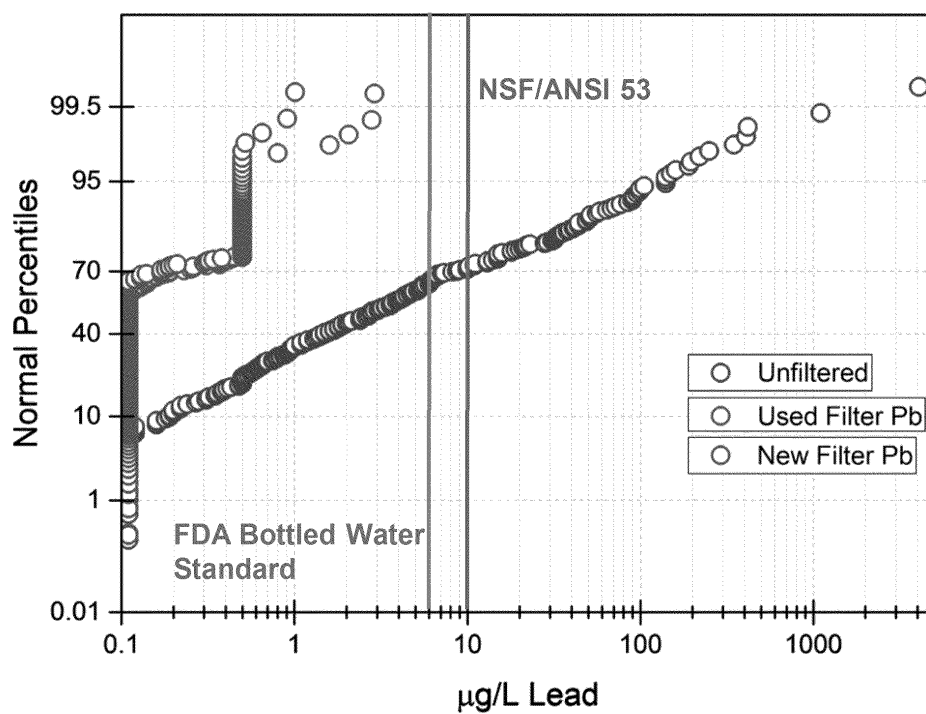


EPA POU Device Performance Assessment—Used Tap Filter

Parameter	Units	Summary of Filter Grab Results (January 30, 2016 - May 6, 2016)					
		Filtered Water - Used Tap Filter					
		Minimum	Maximum	Median	Average	Standard Deviation	Number of Results
Aluminum	mg/L	Non-Detect (<0.009)	0.33	Non-Detect (<0.009)	0.0509	0.0747	210
Cadmium	ug/L	Non-Detect (<0.061)	Non-Detect (<2)	Non-Detect (<0.061)	0.4487	0.7275	210
Calcium	mg/L	Non-Detect (<0.2)	32.4	26	22.4	8.0	210
Chromium	ug/L	Non-Detect (<0.2)	Non-Detect (<5)	Non-Detect (<0.2)	1.2	2.0	210
Copper	ug/L	Non-Detect (<0.75)	120	Non-Detect (<0.75)	2.1	9.5	210
Iron	mg/L	Non-Detect (<0.016)	0.88	Non-Detect (<0.016)	0.0375	0.0691	210
Lead	ug/L	Non-Detect (<0.11)	2.9	Non-Detect (<0.11)	0.2568	0.3433	210
Magnesium	mg/L	Non-Detect (<0.048)	11.2	8.1	7.9	2.0	210
Manganese	mg/L	Non-Detect (<0.0011)	0.068	0.0016	0.0040	0.0059	210
Nickel	mg/L	Non-Detect (<0.00023)	0.0116	0.00032	0.0014	0.0022	210
Potassium	mg/L	0.21	70	1.385	5.3	10.4	210
Sodium	mg/L	0.98	80	5.39	9.3	9.9	210
Tin	mg/L	Non-Detect (<0.02)	Non-Detect (<0.02)	Non-Detect (<0.02)	0.0200	0.0000	6
Zinc	mg/L	Non-Detect (<0.0073)	0.26	Non-Detect (<0.0073)	0.0152	0.0285	210

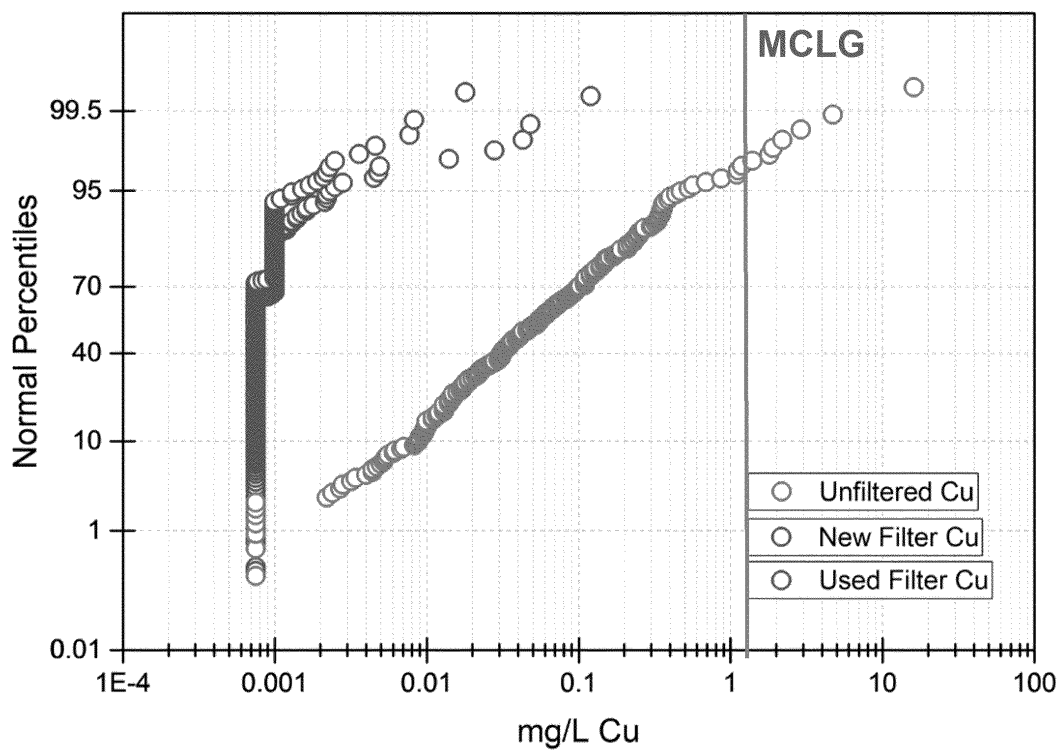


Performance with Pb Removal (Certified)—Kitchen tap





Performance with Cu Removal (Uncertified)—Kitchen tap



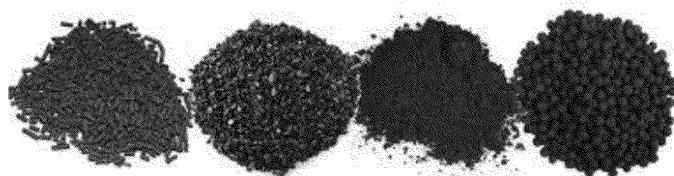


What ARE these POU devices???



Activated Carbon

- ☐ Primarily sourced from:
 - ☐ Coconut
 - ☐ Wood
 - ☐ Charcoal
- ☐ Sizes range from powder (PAC) to granular (GAC)

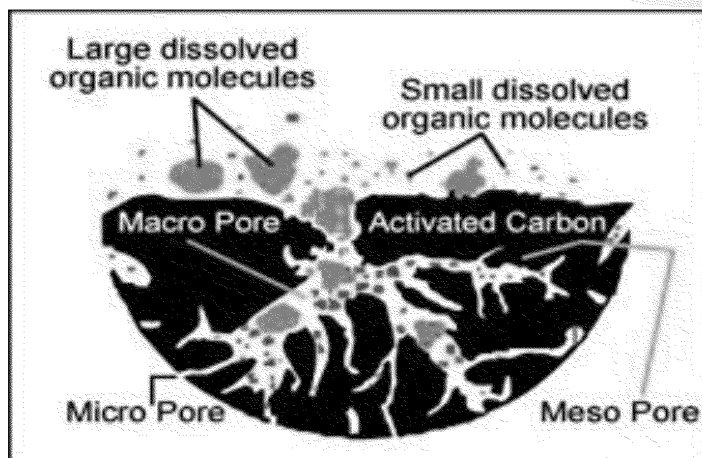


*Courtesy of PUR,
Marlborough, MA



Design of Currently Available POU Filters

- ☐ 3 pore sizes
 - ☐ Macropores (>50 nm)
 - ☐ Mesopores (≥ 2 - ≤ 50 nm)
 - ☐ Micropores (< 2 nm)
- ☐ Contact time is critical
- ☐ Grinding activated carbon increases the surface area



*Courtesy of PUR,
Marlborough, MA



**So, Now That We Know *How* They
Worked....**

**Let's Look At *Why* They Worked:
The Certification and Standards
Framework**



NSF/ANSI 42 and 53

- ☐ NSF/ANSI 42 for Aesthetic Effects

- ☐ Example claims:

- ☐ Chlorine Reduction

- ☐ Zinc Reduction

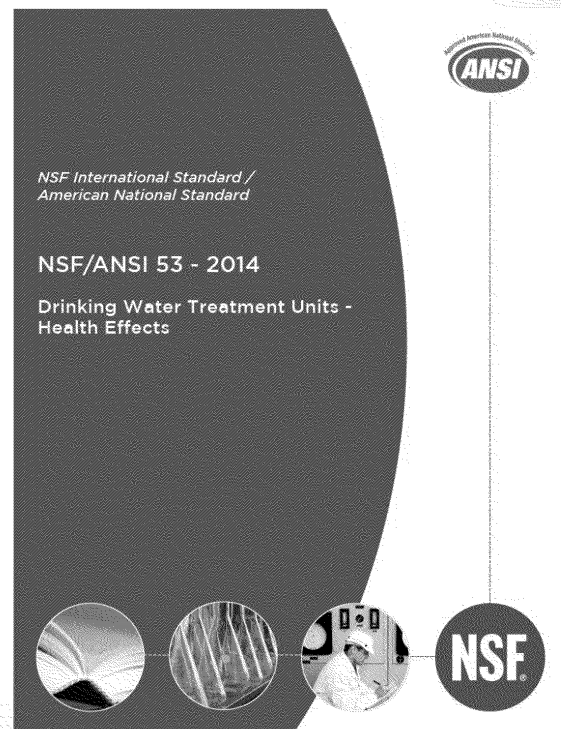
- ☐ NSF/ANSI 53 for Health Effects

- ☐ Example claims:

- ☐ Arsenic Reduction

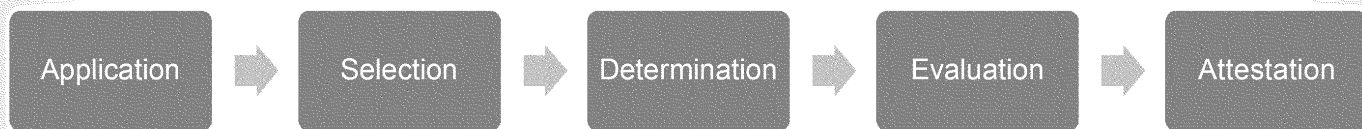
- ☐ Mercury Reduction

- ☐ Lead Reduction





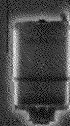
General Certification Process



How to find a certified product

PÜR

Experience crisp, clean, refreshing.
To learn more, visit rurwater.com.



Filtra 100 galones/1,600 tazas de
8 oz por filtro o dura hasta 3 meses.

All PUR faucet refills fit in all PUR faucet mount systems.
Todos los repuestos de grifo PUR se pueden utilizar con cualquier sistema de unidad de montaje para grifo PUR.

WITH
MAXION
FILTER TECHNOLOGY

MAXION Filter Technology is PUR's unique formulation approach for blending carbon and ion exchange materials for maximum contaminant reduction. Clean drinking water is the foundation of good health. PUR faucet mount filtration systems with MAXION technology turn your ordinary tap water into clean, fresh-tasting drinking water.

PUR faucet mount filtration systems with MAXION technology are certified to reduce the following harmful contaminants:

Contaminants Reduced	Potential Health Effects	Source
Microbial Cysts: <i>Giardia lamblia</i> , <i>Cryptosporidium</i>	Short-term gastroenteritis (stomach illness)	Human and animal fecal waste
Metals: Lead, Mercury	Infants and children: delays mental & physical development Adults: kidney problems, neurological problems	Corrosion of household plumbing; erosion of natural deposits
Industrial Chemicals: Carbon tetrachloride, trichloroethylene (TCE)	Liver problems; increased risk of cancer	Discharge from factories or chemical plants
Herbicides/Pesticides: 2,4-D	Kidney, liver, or adrenal gland problems	Runoff from herbicides used on row crops
Chlorinated By-Products: Trihalomethanes (THMs)	Birth, kidney or liver & nervous system problems; increased risk of cancer	By product of drinking water disinfection

BOOKS IN THE FIELD OF POLITICAL SCIENCE

PUR also reduces these substances that may be in your tap water:

Chlorine (taste and odor)	Sediment (Particulate Class I)	Pharmaceuticals
---------------------------	--------------------------------	-----------------

[†]See Performance Data Sheet for the specific pharmaceutical compounds reduced by this device.

[illegible]

Sistema Testado e Certificado por NTF Internacional segun el NTP-003. Modulo 42, 53 and 49
 for the evaluation of the claims specified on the Performance Data Sheet.

Sistema Probad y Certificado por NTF Internacional segun el NTP-003. Modulo 42, 53 y 49
 para la evaluacion de la afirmaciones especificadas en la Hoja de Datos de Rendimiento.



Sistema Unificado de Control por Rádio - 401 MHz Standard 41, 53 and 401 for the use of the clubs specified on the performance table below.

*Courtesy of
PUR,
Marlborough,
MA



How to find a certified product

	<ul style="list-style-type: none"> • Remove the cover. • Slowly turn or twist the filter cartridge. This will help loosen the filter.
Technical Specifications:	
FILTER CAPACITY:	100 gallons (378 liters) up to 3 months
RATED SERVICE FLOW:	0.52 gallons/minute (2.0 liters/minute) at 60 psig
MAXIMUM TEMPERATURE:	100°F (38°C)
MINIMUM TEMPERATURE:	34°F (1°C)
MAXIMUM WORKING PRESSURE:	100 psig (690 kPa)
MINIMUM WORKING PRESSURE:	20 psig (138 kPa)
<p>For system to perform as shown in the Performance Data Sheet, it is necessary to replace the filter when it exceeds filter capacity (100 gallons).</p>	
<p>Testing was performed under standard laboratory conditions, actual performance may vary.</p>	
<p>The contaminants or other substances removed or reduced by this water filter are not necessarily in all users' water. Do not use with water that is microbiologically unsafe, or of unknown quality, without adequate disinfection before or after the system. Systems that are certified for cyst reduction may be used on disinfected water that may contain filterable cysts. Individuals requiring water of certain microbiological purity should consult their physician. Replacement filters may be purchased at most retail outlets or at purwater.com.</p>	
	<p>FM-2000B, FM-3223B, FM-3323BMM, FM-3400B, FM-3500B, FM-3700B, FM-4000B, FM-4100B, FM-9000B, FM-9100B, FM-9400B, FM-9500B</p> <p>Systems Tested and Certified by NSF International against NSF/ANSI Standards 42, 53 and 401 for the reduction of the claims specified on the Performance Data Sheet.</p>
	<p>FM-2000B, FM-3223B, FM-3323BMM, FM-3400B, FM-3500B, FM-3700B, FM-4000B, FM-4100B, FM-9000B, FM-9100B, FM-9400B, FM-9500B</p> <p>Systems Tested and Certified by WQA against NSF/ANSI Standards 42, 53 and 401 for the reduction of the claims specified on the Performance Data Sheet.</p>

*Courtesy of
PUR,
Marlborough,
MA



How to find a certified product

Screenshot of the Water Quality Association (WQA) website showing the navigation menu and a sidebar with links to find certified products.

The website header includes the WQA logo and navigation links: [Learn About Water](#), [Improve Your Water](#), [Programs & Services](#), [About Us](#), and [Careers](#). A search bar is located in the top right corner.

The main content area features a large banner for the **2016 WQA Leadership Conference**, scheduled for August 30 - September 1, 2016, at the Hyatt Regency Newport, Newport, Rhode Island. The banner includes a "REGISTER TODAY" button and a link to "Find Certified Products".

The sidebar on the right contains a list of links:

- [Find Certified Products](#)
- [Find Water Treatment Providers](#)
- [Find Certified Professionals](#)
- [Find Jobs in Water](#)

The footer section includes "Recent News" (WQA offers free Water Treatment for Dummies booklet), "Facebook Feed" (Water Quality Association), and "Quick Links" (Professional Certification & Training Program).



How to find a certified product

Agent Trial Balance - Del... Find Gold Seal Certified... Find Gold Seal Certified... WQA - Intranet... WQA - Intranet... WQA - Intranet... Sign in to Concur | Com... periodic table - Google... Find Gold Seal Certified... Item... GP Reports

https://www.wqa.org/find-products/

Apps | M | Inbox (26) | fspoden... Work | FS | articles | 9 | hotels/points | Helpdesk | Paychex Flex | Engage: Log in to th... Google Scholar | BenUConnect | Product Certification | GP Reports

Product Certification Login | Member Login | Join WQA

Water Quality Association

Learn About Water | Improve Your Water | Programs & Services | About Us | Careers

Home > Programs & Services > Product Certification > Resources > Find Certified Products

Find WQA-Certified Water Treatment Products

WQA's Certified Product Listings are available to help connect consumers with water treatment products that have been tested and certified to industry standards. WQA maintains a complete listing of all products and components that have earned the [Gold Seal and Sustainability Certification Marks](#). Only products that pass the rigorous testing requirements of industry standards, pass annual manufacturing facility audits, and comply with WQA's Certification Schemes can be found in this listing.

User Tips

1. To search for certified water treatment products, enter the manufacturer name, brand name or model number into the search bar below.
2. Please enter at least three characters in the search bar. A space counts as a character when entering a two-letter word.
3. Check the Advanced Search box to further narrow your search by the manufacturer's home country, the product standard, product type and reduction claim.
4. Once the search results appear, you may click on the name for a description of the standard or the manufacturer for the official product listing.
5. When using the Advanced Search, please note that the Country menu will display results according to the country in which the manufacturing company is based, which is not necessarily the country where the product is manufactured or sold.

Manufacturer / Brand / Model ☒ Advanced Search

Advanced Search

Country	Product Standard	Product Type	Reduction Claim
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

No results

1:29 PM 8/5/2018



How to find a certified product

Screenshot of the EPA's Find Gold Seal Certified Products website. The browser address bar shows the URL: https://www.epa.org/find-products/cti/detail/mid/1054/csd/kat_ces_inc/sid/2/keyword/D. The page displays a table of certified products with columns for Material, Model, Flow Rate, and Capacity. A list of chemicals is shown on the right side of the table, including 2,4,5-TP, 2,4-D, Asbestos, Atrazine, Benzene, Carbofuran, Carbon Tetrachloride, Chlordane, Chlorobenzene, Cyst, Endrin, Ethylbenzene, Heptachlor Epoxide, Lead, Lindane, Mercury, Methoxychlor, Methyl Tert-Butyl Ether (MTBE), o-Dichlorobenzene, Simazine, Styrene, Tetrachloroethylene, Toluene, Toxaphene, TTHM (as chloroform), Turbidity, and VOC (as chloroform). The table lists three products: PUR FM-2000B, PUR FM-3000, and PUR FM-3333B, all with a flow rate of 0.52 GPM and a capacity of 100. The chemicals list is repeated for each product.

Material	Model	Flow Rate	Capacity
PUR	FM-2000B	0.52 GPM	100
PUR	FM-3000	0.52 GPM	100
PUR	FM-3333B	0.52 GPM	100

Chemicals listed on the right:

- 2,4,5-TP, 2,4-D, Asbestos, Atrazine, Benzene, Carbofuran, Carbon Tetrachloride, Chlordane, Chlorobenzene, Cyst, Endrin, Ethylbenzene, Heptachlor Epoxide, Lead, Lindane, Mercury, Methoxychlor, Methyl Tert-Butyl Ether (MTBE), o-Dichlorobenzene, Simazine, Styrene, Tetrachloroethylene, Toluene, Toxaphene, TTHM (as chloroform), Turbidity, VOC (as chloroform)



NSF/ANSI 53 – Performance Testing

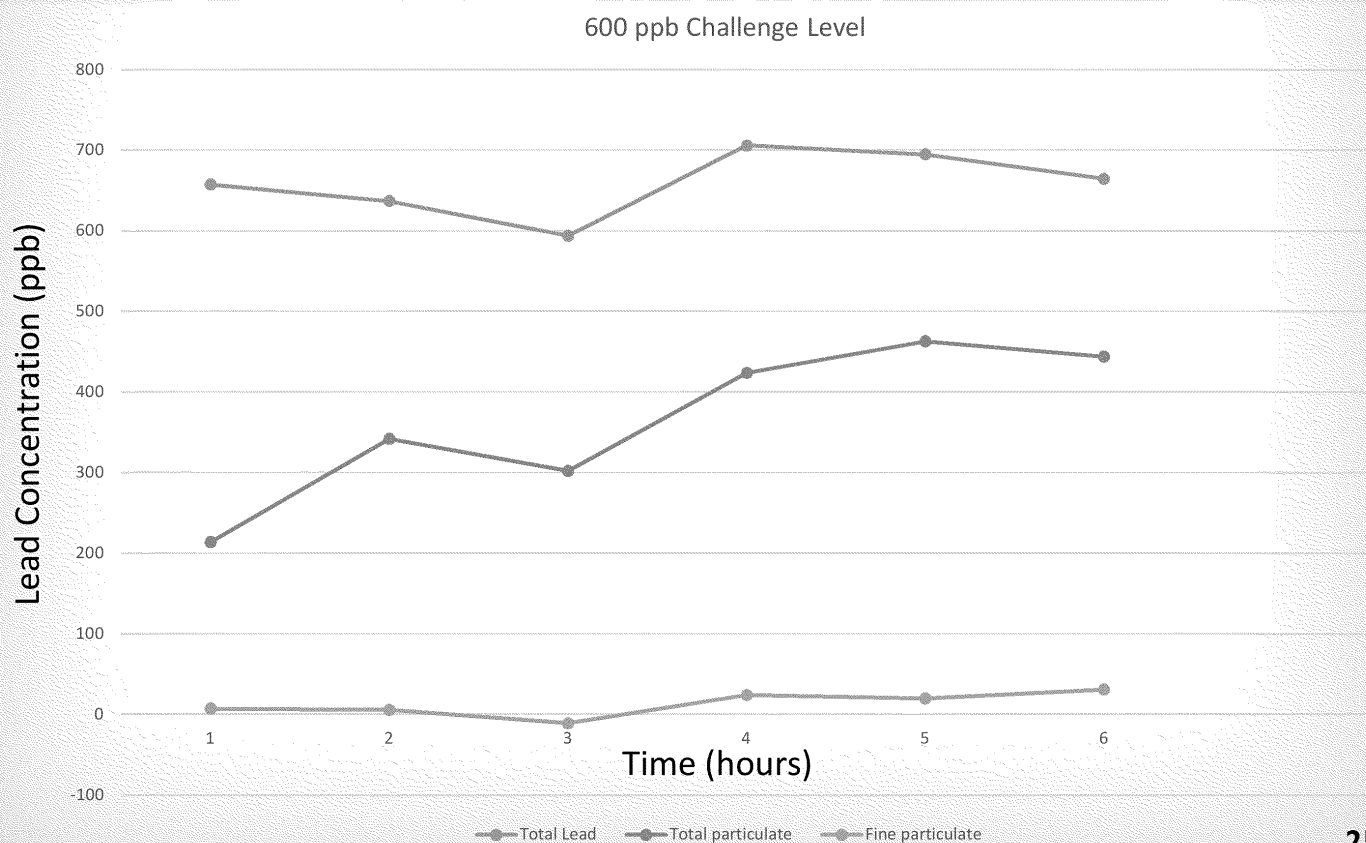
- ☐ Testing and confirmation of performance claims on a technology specific protocol
- ☐ NSF/ANSI 53 protocol for lead reduction
 - ☐ Low (6.5) and high (8.5) pH
 - ☐ Gives different percentages of particulate and soluble metals
 - ☐ Usage pattern – Time spent on versus off over 16 hours
 - ☐ 50/50
 - ☐ 10/90
 - ☐ Performance Indicators (PID)
 - ☐ With PID, tested to 120% of capacity
 - ☐ Without PID, tested to 200% of capacity

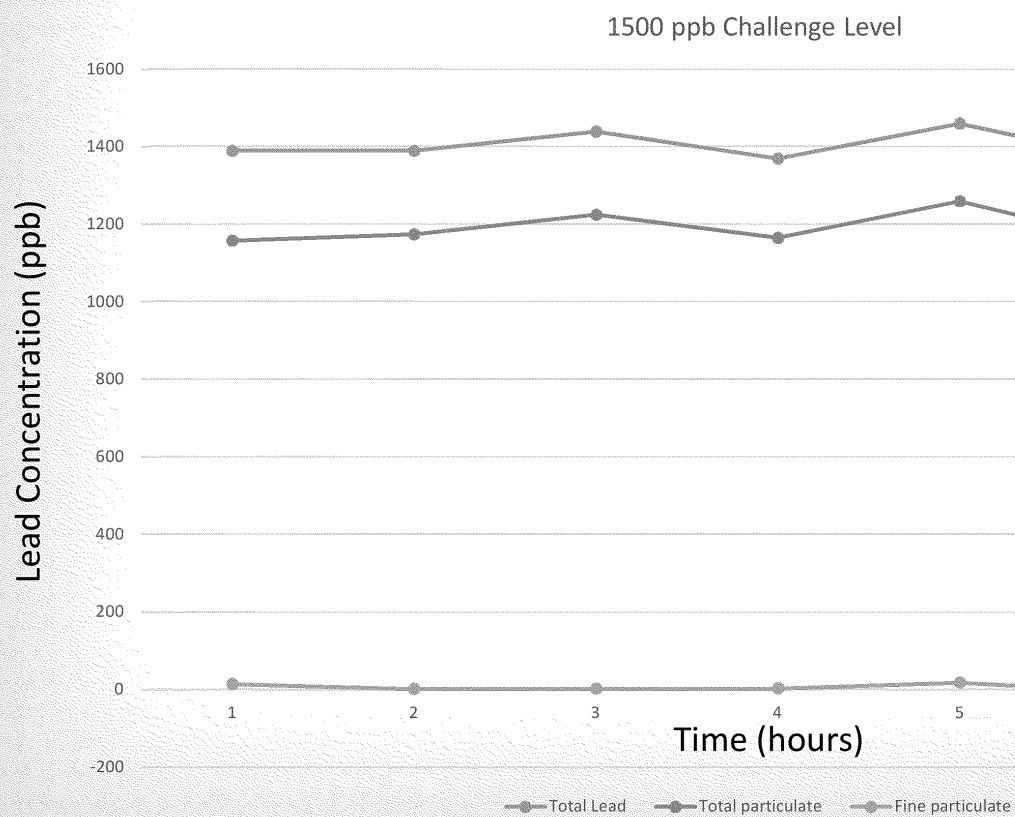


Challenges of NSF/ANSI 53 water at high levels

Substance	Influent Challenge	Overall average tolerance	Single point tolerance	Maximum effluent conc. Mg/L	USEPA method	Compound
Lead [Pb _i] <i>Total lead</i>	0.15 mg/L	± 10%	± 20%	0.010	200.8 200.9	Pb(NO ₃) ₂
Lead %[Pb _{tp}] <i>Total Particulate</i>	30%	± 10%	± 20%	n/a	200.8 200.9	
Lead %[Pb _f] <i>Fine Particulate</i>	≥ 20%	n/a	n/a	n/a	200.8 200.9	

NSF/ANSI 53 – 2015 Drinking Water Treatment Units – Health Effects







Does this matter?

- ☐ Why do we care?
- ☐ Goal is to match the standard
 - ☐ Cannot add lead to the water in NSF/ANSI 53 and have it work
 - ☐ The standard does not match field data for atypical events (like Flint)
- ☐ So how would real POU filters hold up in the field given this information?



Field Data on a POU filter

	Average Pb Influent (ppb)	Average Pb Effluent (ppb)
Carbon Block Technologies, Inc.*	300	0.25
PUR**	659	2.3

*Courtesy of Carbon Block Technologies, Inc., Las Vegas, NV

**Courtesy of PUR, Marlborough, MA



Conclusions

- ☐ Properly certified POU devices operated with manufacturer's specifications were effective at removing both dissolved and particulate lead, even to levels much below 10 µg/L for Pb
- ☐ POU models tested were also effective at removing dissolved and particulate copper to below MCLG of 1.3 mg/L (no way to tell fraction of each from sampling), though not certified.
- ☐ Devices used and tested achieved removal superior to FDA bottled water standard (5 µg/L).
- ☐ Point of use products are a viable option for immediate and short term treatment
- ☐ POU devices are an important barrier against unpredictable sporadic lead release from LSLs, accumulated on interior plumbing materials, and eroded from leaded solder and brass



Recommendations

- ☐ Find a certified product through certifier's listings or by reading the boxes
- ☐ When possible, use a certified professional to have them installed
- ☐ Test the water before and after installation to assure proper functioning
- ☐ Seek out credible resources for information and guidance, such as EPA and the Water Quality Association



Questions?

Contact

Michael Schock, schock.michael@epa.gov

Tom Spoden, tspoden@wqa.org

Acknowledgments

- USEPA Region 5
- PUR
- Carbon Block Technologies, Inc.

